CICER MILKVETCH FOR WESTERN CANADA

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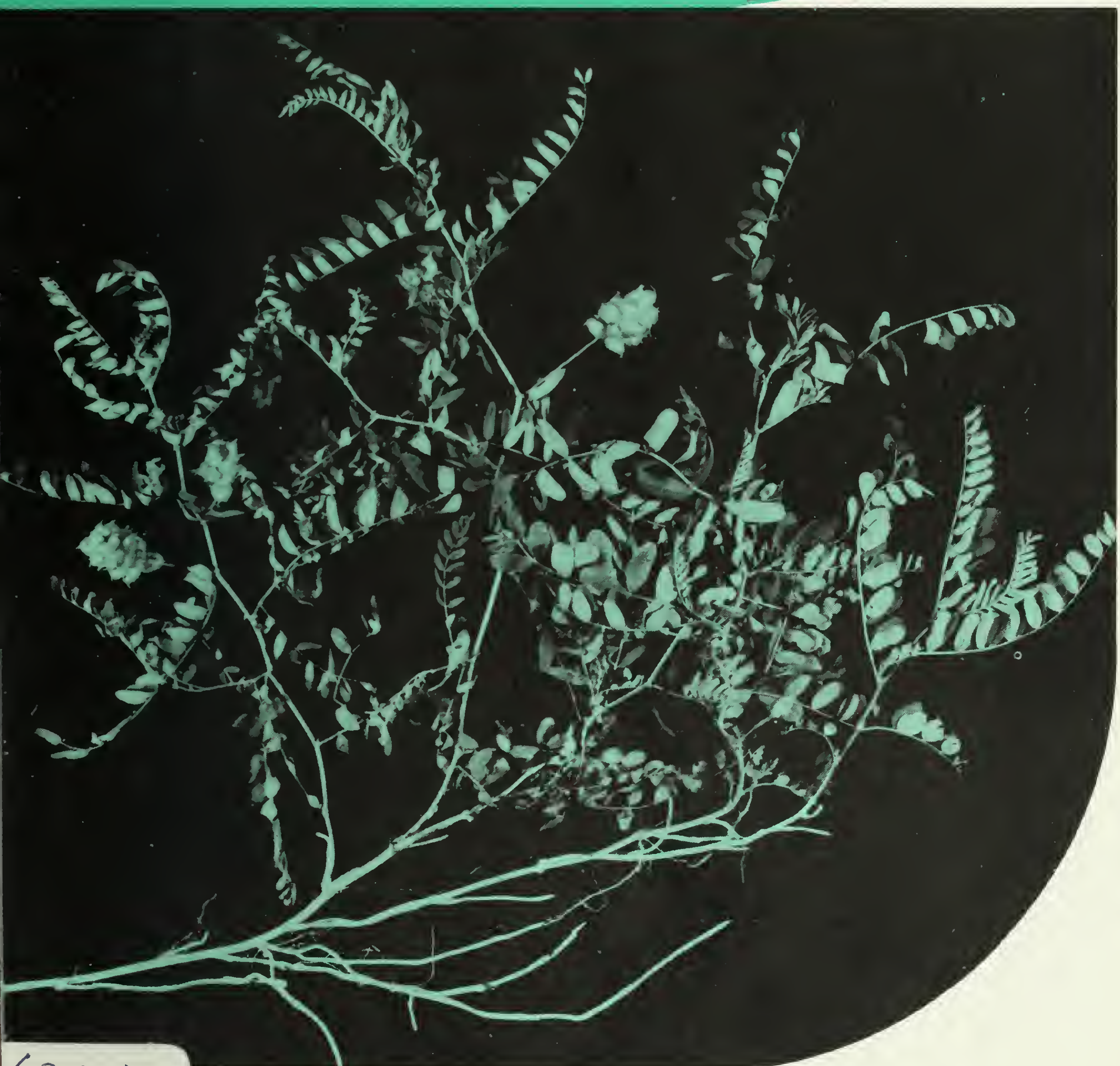

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- Cicer milkvetch is a new forage legume suitable for planting on ranges and pastures
- It is best adapted to the Black soil zone of southwestern Alberta but it also grows well throughout the rest of the Black soil zone and in the Dark Brown soil zone
- Most of the seeds have hard coats that need to be scarified by mechanical abrasion before planting; also, the seeds have to be inoculated with *Astragalus* bacterial inoculant before they are planted
- Plant seeds 3/4 in. (19 mm) deep in a firm, weed-free seedbed with the use of a depth-control device on your seed drill
- Spring seeding is recommended
- Cicer milkvetch, either alone or mixed with grasses, is a good pasture legume; it is not known to cause any physiological problems such as bloat
- Cicer milkvetch, an introduced species, does not accumulate selenium, as do certain of our native species of *Astragalus*
- In nutritive value, cicer milkvetch is similar to alfalfa; it provides nutritious forage until late fall

CICER MILKVETCH FOR WESTERN CANADA

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INTRODUCTION

Cicer milkvetch (*Astragalus cicer* L.) is a new forage legume suitable for range and pasture plantings (Fig. 1). It is adapted to the Dark Brown and Black soil zones of Western Canada. Although it has been tested in nursery rows ever since its introduction from the USSR in 1931, it attracted little interest until recently because of the difficulty of establishing good stands.

In Europe, where cicer milkvetch is native, it is found in cool, moist locations along streams and ditches, in open woodlands, and on floodplains. The species occurs from northern Spain to Finland and Sweden and eastward to north central and southeastern Russia.

In North America, research is being done on cicer milkvetch in Colorado, Oregon, Wyoming, Montana, and Alberta. Three varieties have been developed and released, and the species is slowly finding its place in agriculture.

This publication describes the characteristics, range of adaptation, establishment methods, and management for forage and seed production of cicer milkvetch.

CHARACTERISTICS

Cicer milkvetch is a long-living, perennial, herbaceous legume with a vigorous, creeping root system (Fig. 2). The crowns of well-spaced single plants growing under favorable conditions may increase by as much as 30 in. (76 cm) in diameter in 1 year. The crowns of volunteer plants on rangeland in the Black soil zone have reached 48 in. (122 cm) in diameter over several years.

Stems are hollow and succulent. They grow upright when the plant is young but become decumbent to trailing as growth continues. Under favorable conditions, stems may be 4 ft (1.2 m) long, but the aboveground height of the foliage seldom exceeds 2 ft (60 cm). Stems tend to be more upright when the crop is grown with grasses than when growing alone.

Leaves are pinnately compound with 16–20 leaflets. Leaf retention during cutting and handling is better than that of alfalfa.

Fig. 1 Sheep on a pasture of cicer milkvetch at Lethbridge.

Flowers are pale yellow to white and are borne in racemes (Fig. 3). Each raceme or spikelike head contains 5–40 flowers. Pollination is accomplished mainly by native bumble bees, although honey bees also often work in stands of cicer milkvetch. Stands in full flower have a sweet, fragrant smell. The greenish to reddish green seedpods become inflated after pollination and turn black and leathery as the seeds mature (Fig. 4). Pods do not shatter and seeds may be retained until spring.

Each seedpod contains 2–11 bright yellow to pale green, flat, rounded seeds that are about twice as large as alfalfa seeds. The seeds have hard, shiny seed coats (Fig. 5), which protect them during threshing or cleaning. However, the seeds have to be scarified to ensure adequate germination and establishment of the stand.

Because of the great variability among plants of the species, there appears to be potential for improvement by plant breeding techniques. For example, there are differences in date of emergence of seedlings, spring growth, color of foliage, degree of creep, growth habit, number of flowers, seed-setting ability, days to seed maturity, seed size, and yield of forage and seed.

ADAPTATION

The principal area of adaptation of cicer milkvetch appears to be the Black soil zone of southwestern Alberta, but it also grows well throughout the rest of the Black soil zone and in the Dark Brown soil zone. It can be grown also on moist locations in the Brown soil zone. It is adapted to a wide range of soil textures, but shows the creeping habit best on moderately coarse to coarse textured soils. It is adapted to subirrigated sites.

Fig. 2 Creeping roots, trailing stems, leaves, and seedpods of cicer milkvetch.

Cicer milkvetch has been used in roadside plantings to prevent erosion in the Swan Hills of north central Alberta. It is useful for restoring and revegetating disturbed areas.

Cicer milkvetch has been tested at numerous locations in Western Canada and has been found to be very winter-hardy. At Drumheller, Claresholm, Pincher Creek, and Manyberries, in Alberta, and Mile 1019, in the Yukon Territory, cicer milkvetch survived, whereas other legumes such as alfalfa, clover, vetch, and birdsfoot trefoil were killed out in 3–5 years. Cicer milkvetch is more frost tolerant than alfalfa. It is moderately salt tolerant and drought resistant. Reports disagree on its degree of tolerance for flooding.

The creeping root system of cicer milkvetch is better able to withstand damage by pocket gophers than the taproot system of alfalfa.

VARIETIES

Cicer milkvetch was first grown in Canada at the Research Substation, Canada Department of Agriculture, Manyberries, Alberta, from 1931 to 1946. It was also grown at the Research Station, Lethbridge, Alberta, from 1946 to 1950, and at the Research Substation, Stavely, Alberta, from 1950 to the present. After a few years, the seeding at Stavely successfully invaded established stands of timothy (*Phleum*

Fig. 3 (Left) Various shapes of racemes of cicer milkvetch.

Fig. 4 (Right) Seedpods darken as the seeds mature.

pratense L.). Because of its persistence and competitive ability when established, an intensive study of the Stavely strain was undertaken in 1964. This study resulted in the release of the variety Oxley in 1971.

In 1970, the Montana State University, the University of Wyoming, and the Soil Conservation Service Plant Materials Center released a variety of cicer milkvetch name Lutana. Another U.S. variety that was released earlier was named Cicar.

SEED GERMINATION

Cicer milkvetch produces a high percentage of seeds with a hard or impervious seed coat. Hard seeds are common among members of the legume family; they resist abrasion, are often covered by a waxlike layer, and are impermeable to water or air. The seed coat may be broken down or punctured during threshing and cleaning, by attack from soil microbes, or by exposure to alternating temperatures, which expand and contract the seed coat and crack it. However, these methods are unreliable and should not be depended upon for adequate germination. Therefore, it is best to scarify the seed, and then germination can proceed. The seed can be scarified anytime within 6 months before seeding.

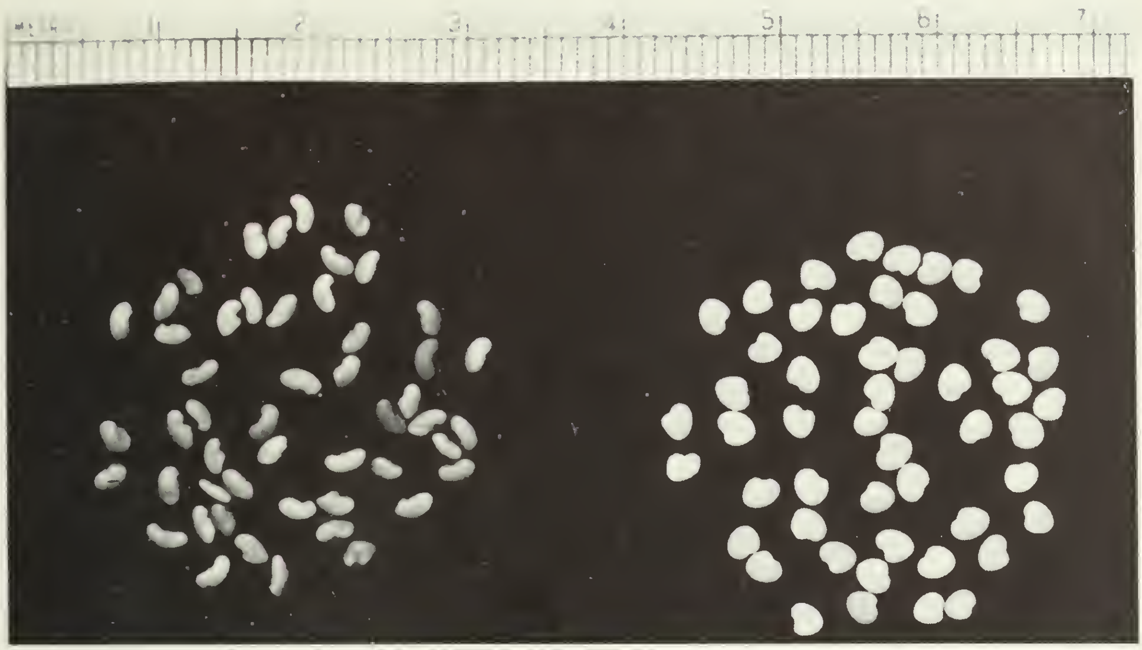

Fig. 5 Seeds of (*left*) alfalfa and (*right*) cicer milkvetch.

Scarification is the act of chipping or cracking the seed coat by mechanical abrasion. This may be done in a commercial scarifier by the company that provides the seed. Or, you can scarify the seed yourself by rotating it in a cement mixer lined with screening, or running it through a feed grinder with plates set just far enough apart to grind only a small amount of the seed.

The degree of scarification should be checked on small samples of the seed. Early studies with sweetclover showed that the proportion of scarified seed could be determined by soaking the seed in water and then counting the swelled seeds. In Montana, Stroh and his associates used the quick-swell test to predict germination of scarified cicer milkvetch seed. (The quick-swell test consists of placing a known

Table 1 Emergence of unscarified and scarified cicer milkvetch seed at various soil depths

Depth of soil	Emergence of seed, %	
	Unscarified	Scarified
1/4 in. (6 mm)	7	36
1/2 in. (13 mm)	8	30
3/4 in. (19 mm)	8	30
1 in. (2.5 cm)	6	25
1 1/4 in. (3.2 cm)	4	9
1 1/2 in. (3.8 cm)	7	7
1 3/4 in. (4.4 cm)	4	6
2 in. (5.1 cm)	1	1
2 1/4 in. (5.7 cm)	2	0
2 1/2 in. (6.4 cm)	0	0

number of scarified seeds on a moist blotter or towel for 24 hours at room temperature and determining the percentage of seeds that swell to about double their normal size.) Field germination and emergence are usually adequate when the quick-swell count is between 30 and 50%. The test is fast, simple, and useful for adjusting a scarifier.

INOCULATION AND FERTILIZER REQUIREMENTS

Cicer milkvetch requires a specific strain of *Rhizobium* bacterial inoculant that differs from the one needed by alfalfa, sainfoin, and other legumes. It is called *Astragalus* inoculant and can be bought from seed companies and farm supply outlets that handle cicer milkvetch seed. Just before planting, inoculate the seed by following the instructions on the container.

Test your soil to find out if it needs fertilizer. If your soil is low in phosphorus, incorporate phosphorus (P_2O_5) at 200 lb or more/ac (about 224 kg/ha) into the soil when you are preparing the seedbed. This treatment will increase seedling growth and survival. Do not apply nitrogen fertilizer at seeding, because it stimulates weed growth. Older stands may need P_2O_5 at 70 lb or more/ac (78 kg or more/ha) annually in some areas. Nitrogen fertilizers may be used when grass is grown in a mixture with cicer milkvetch.

SEEDING

Cicer milkvetch may be difficult to establish. When seeding cicer milkvetch more attention must be paid to preparing a firmly packed, weed-free seedbed than for alfalfa. Plant seed not more than 1/2–3/4 in. (13–19 mm) deep; a depth-control device on the seed drill is useful. Spring seeding is best, although seedings on irrigated land at Lethbridge in August resulted in good stands. Do not plant companion crops with cicer milkvetch.

Rates of seeding:

Black soil zone	6–7 in. (15–18 cm) row spacing	10–12 lb/ac (11–13 kg/ha)
Dark Brown soil zone	12–18 in. (30–46 cm) row spacing	6–8 lb/ac (7–9 kg/ha)
Seed production (Fig. 6)	24–36 in. (61–91 cm) row spacing	3–5 lb/ac (3–6 kg/ha)

Although cicer milkvetch is slow to establish because of low seedling vigor and slow seedling emergence, good stands have been obtained in the year of seeding (Fig. 7).

Seedling growth of cicer milkvetch is slower than that of alfalfa; established stands start growing about 3 weeks later in the spring, but they continue growing and stay green longer in the fall.

Attempts to establish cicer milkvetch at various locations in the Black soil zone with the use of herbicides and minimum cultivation have failed. The failure of this

Table 2 First-year forage yields of cicer milkvetch strains seeded at Stavely, Alberta

Strain or variety	Yield of forage	
	lb/ac	(kg/ha)
Oxley	1,120	(1,258)
Wyoming	936	(1,048)
Lutana	682	(764)
Idaho	595	(666)

method is further proof that well-prepared land is essential for successful stand establishment.

WEED CONTROL

Weed competition in the year of seeding may seriously affect the growth of young plants, therefore, a clean seedbed is essential. Weeds that compete with the young cicer milkvetch seedlings can be mowed without damaging the crop. When grown for seed production, spaced-row plantings of cicer milkvetch can be cultivated for weed control.

No herbicide has yet been licensed for use on cicer milkvetch, although both preemergence and postemergence treatments recommended for other forage legumes have been used successfully on the crop in limited tests. Applications of herbicides in early spring before cicer milkvetch starts growing may control some of the weeds.

Fig. 6 This field of cicer milkvetch was seeded in 2–3 ft (61–91 cm) spacings for seed production.

FORAGE PRODUCTION

Pasture Production

Cicer milkvetch, alone and mixed with crested wheatgrass (Fig. 8), was grazed by sheep for 5 years at Lethbridge without causing any physiological problems such as bloat. In this test, the apparent consumption of cicer milkvetch equaled that of alfalfa.

Table 3 Production and apparent consumption (by ewes) of three legumes seeded at Lethbridge in 1967

	Yield compared with alfalfa, %					Apparent consumption of total production, %				
Legume	1968	1969	1970	1971	1972	1968	1969	1970	1971	1972
Alfalfa	100	100	100	100	100	60	65	68	65	79
Sainfoin	108	122	99	101	95	83	73	61	73	88
Cicer milkvetch	43	63	70	79	61	73	67	59	61	74

Field-scale plantings were grazed in tests conducted at Claresholm and Nanton, Alberta. The ability of cicer milkvetch to produce nutritious forage late in the season was its most important characteristic at both locations.

Hay Production

Hay production tests with cicer milkvetch were conducted at Lethbridge, in the Dark Brown soil zone, and at Stavely, in the Black soil zone. Forage production of cicer milkvetch at Lethbridge was about 70% that of alfalfa, but, because of its resistance to damage by pocket gophers, it outyielded alfalfa by about 35% at Stavely.

Cicer milkvetch recovers more slowly after cutting or grazing than alfalfa.

Table 4 Forage dry matter production in t/ac (tonnes/ha) from stands of Oxley cicer milkvetch and Rambler alfalfa in mixed and alternate rows with Nordan crested wheatgrass, Sawki Russian wild ryegrass, and Greenleaf pubescent wheatgrass at Lethbridge

	4-year average			
	Mixed rows		Alternate rows	
Crop	t/ac	(tonnes/ha)	t/ac	(tonnes/ha)
Oxley + Nordan	2.6	(5.8)	2.8	(6.2)
Oxley + Sawki	2.7	(6.0)	2.9	(6.4)
Oxley + Greenleaf	2.3	(5.1)	2.7	(6.0)
Rambler + Nordan	3.4	(7.6)	3.6	(8.0)
Rambler + Sawki	3.3	(7.3)	3.9	(8.7)
Rambler + Greenleaf	3.2	(7.1)	3.9	(8.7)
Oxley alone	1.8	(4.0)		
Rambler alone	3.1	(6.9)		

First-year yields of Oxley cicer milkvetch exceeded those of other cultivars at Stavely (Table 2).

Nutritive Value

In grazing tests, cicer milkvetch did not cause bloat in animals. Unlike certain native milkvetches, it does not accumulate high levels of selenium, as shown by a comparison of the selenium content of several species: alfalfa, 2.5 ppm; cicer milkvetch, 8.8 ppm; two-grooved milkvetch, 1,054 ppm; and narrow-leaved milkvetch, 2,500 ppm.

When fed to sheep in a digestibility trial, the digestible energy content of cicer milkvetch compared favorably with that of alfalfa, as shown by the following data:

	Cicer milkvetch	Alfalfa
Dry matter digestibility, %	61.5	59.6
Crude protein, %	14.6	14.8
Apparent digestibility of protein, %	72.8	71.0
Digestible energy, kcal/lb	1,019	1,002
(kcal/kg)	(2,249)	(2,211)

The rate of and the total digestion of dry matter of cicer milkvetch at four stages of growth, prebloom, 25% bloom, seed ripe, and after fall frosts, measured by the nylon-bag technique in fistulated cows, showed little difference in relative digestibility among these stages (Fig. 9). These figures agree with the observation that cicer milkvetch is a nutritious forage until late fall.

SEED PRODUCTION

Cicer milkvetch is a cross-pollinated species. Native bumble bees are the most important pollinating insects. However, observations at Lethbridge in 1973 indicated that honey bees also may be important pollinators. In 1970, seed yields from isolated stands in the Black soil zone averaged 650 lb/ac (728 kg/ha); seed yields from field plantings in cultivated areas have been much lower.

Table 5 Production of dry matter in t/ac (tonnes/ha) of grass—legume mixtures seeded at Stavely

Grass—legume	4-year average t/ac	(tonnes/ha)
Cicer milkvetch	1.2	(2.7)
Alfalfa	0.9	(2.0)
Bromegrass + cicer milkvetch	1.4	(3.1)
Orchardgrass + cicer milkvetch	0.9	(2.0)
Pubescent wheatgrass + cicer milkvetch	1.7	(3.8)
Bromegrass	1.5	(3.3)
Orchardgrass	1.4	(3.1)
Pubescent wheatgrass	1.4	(3.1)

Fig. 7 Cicer milkvetch seedlings are slow to develop and in the seedling year the young plants should not have to compete with weeds for moisture and nutrients.

Fig. 8 Cicer milkvetch and crested wheatgrass growing in alternate rows.

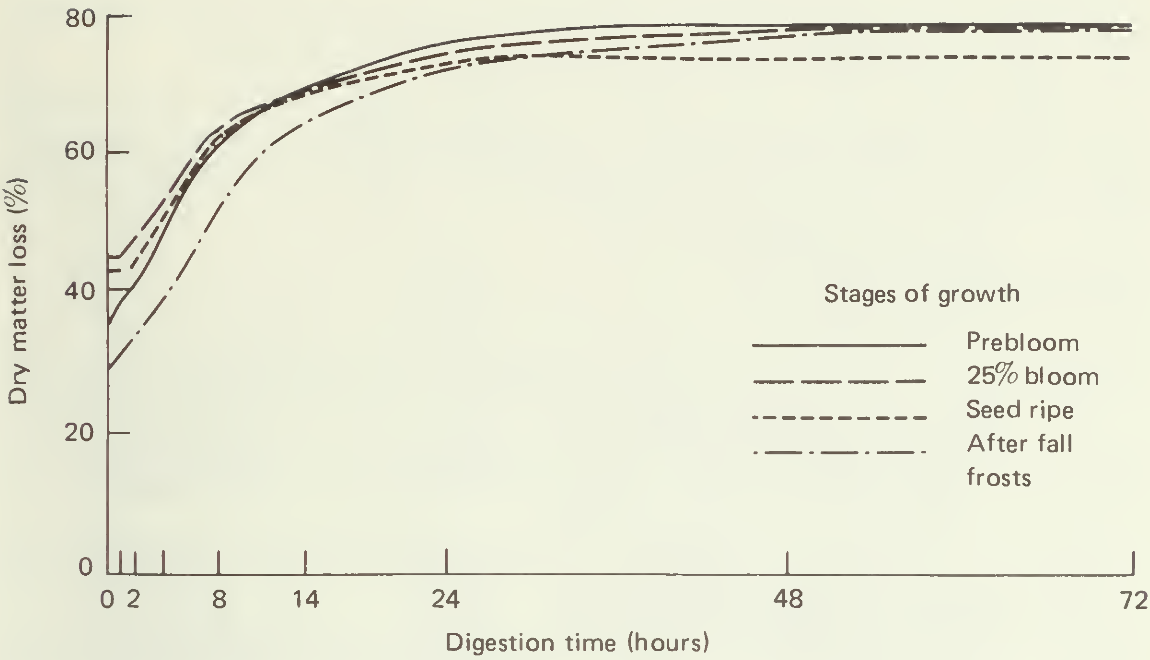

Fig. 9 Rate of digestion of dry matter of cicer milkvetch at four stages of growth, measured by the nylon-bag technique in fistulated cows.

At harvest, the seed crop should be swathed and allowed to dry thoroughly. There is little danger of seed shattering if harvest is delayed a few days or even a few weeks. The pods absorb moisture from the air and become leathery, especially during damp weather. Therefore, the pods should be allowed to become brittle enough to break up easily before threshing.

To thresh cicer milkvetch use a high-speed cylinder (1,500 rpm for an 18-in. [46-cm] cylinder) and a cylinder concave opening of 1/8 in. (3.2 mm). These combine settings do not injure the hard seeds. It may be wise to rethresh the straw and pods to obtain additional seeds.

DISEASES AND PESTS

Cicer milkvetch may be affected by root-, crown-, or stem-rot diseases, although infections, when they occur, usually are light. Of several legumes tested at

Table 6 Percentage of host plants infected after inoculation with a low-temperature basidiomycete

Variety	Plants infected, %
Kane alfalfa	98
Merit white clover	78
Melrose sainfoin	77
Oxley cicer milkvetch	64

Lethbridge, Oxley cicer milkvetch was the most resistant to snow mold, caused by a low-temperature basidiomycete.

Insects that attack cicer milkvetch include aphids, thrips, seed chalcids, sweetclover weevils, and grasshoppers. Sweetclover weevils have been discovered only on newly emerging leaves. Grasshoppers have caused some damage by eating flower buds and seedpods in large fields.

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CONVERSION FACTORS FOR METRIC SYSTEM

Imperial units	Approximate conversion factor	Results in:	
LINEAR			
inch	x 25	**millimetre**	**(mm)**
foot	x 30	**centimetre**	**(cm)**
yard	x 0.9	**metre**	**(m)**
mile	x 1.6	**kilometre**	**(km)**
AREA			
square inch	x 6.5	**square centimetre**	**(cm^2)**
square foot	x 0.09	**square metre**	**(m^2)**
acre	x 0.40	**hectare**	**(ha)**
VOLUME			
cubic inch	x 16	**cubic centimetre**	**(cm^3)**
cubic foot	x 28	**cubic decimetre**	**(dm^3)**
cubic yard	x 0.8	**cubic metre**	**(m^3)**
fluid ounce	x 28	**millilitre**	**(mℓ)**
pint	x 0.57	**litre**	**(ℓ)**
quart	x 1.1	**litre**	**(ℓ)**
gallon	x 4.5	**litre**	**(ℓ)**
bushel	x 0.36	**hectolitre**	**(hℓ)**
WEIGHT			
ounce	x 28	**gram**	**(g)**
pound	x 0.45	**kilogram**	**(kg)**
short ton (2000 lb)	x 0.9	**tonne**	**(t)**
TEMPERATURE			
degree fahrenheit	°F-32 x 0.56 (or °F-32 x 5/9)	**degree Celsius**	**(°C)**
PRESSURE			
pounds per square inch	x 6.9	**kilopascal**	**(kPa)**
POWER			
horsepower	x 746	**watt**	**(W)**
	x 0.75	**kilowatt**	**(kW)**
SPEED			
feet per second	x 0.30	**metres per second**	**(m/s)**
miles per hour	x 1.6	**kilometres per hour**	**(km/h)**
AGRICULTURE			
bushels per acre	x 0.90	**hectolitres per hectare**	**(hℓ/ha)**
gallons per acre	x 11.23	**litres per hectare**	**(ℓ/ha)**
quarts per acre	x 2.8	**litres per hectare**	**(ℓ/ha)**
pints per acre	x 1.4	**litres per hectare**	**(ℓ/ha)**
fluid ounces per acre	x 70	**millilitres per hectare**	**(mℓ/ha)**
tons per acre	x 2.24	**tonnes per hectare**	**(t/ha)**
pounds per acre	x 1.12	**kilograms per hectare**	**(kg/ha)**
ounces per acre	x 70	**grams per hectare**	**(g/ha)**
plants per acre	x 2.47	**plants per hectare**	**(plants/ha)**

Examples: 2 miles x 1.6 = 3.2 km; 15 bu/ac x 0.90 = 13.5 hℓ/ha

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